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APPENDIX C

PASSIVE SOIL-GAS SURVEY

HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

AUGUST 1995

BY
QUADREL SERVICES, INC

Quadrel Report No. QS1287

EMFLUX® Passive, Non-Invasive
Soil-Gas Survey:

HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

Prepared for

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August 31, 1995

CONTENTS

<u>Section</u>		<u>Page</u>
1.0	OBJECTIVE	1
2.0	BACKGROUND	1
3.0	INVESTIGATION PLAN	2
3.1	Approach	
3.2	Survey Plan	
3.3	Site Preparation	
3.4	Field Work	
3.5	Quality Assurance/Quality Control Factors	
4.0	FINDINGS	3
4.1	Computations	
4.2	Data	
5.0	DISCUSSION	4
5.1	Summary	
5.2	Commentary	

APPENDICES

- A Quadrel Field Procedures
- B Field Deployment Report

FIGURES

<u>Figure</u>		<u>Page</u>
1	Overall Site Map	11
2	Methane Detections	12
3	Methane Isopleths	13

TABLES

1	Methane Concentrations (%)	6
2	Average Methane Generation Rates ($\text{ng cm}^{-2} \text{s}^{-1}$)	10

EMFLUX® PASSIVE, NON-INVASIVE
SOIL-GAS SURVEY
of

HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

The following EMFLUX® Methane Survey Report on the HIMCO Dump Superfund Site (HIMCO Dump) has been prepared for the U.S. Army Corps of Engineers (USACE) by Quadrel Services, Inc. (Quadrel) in accordance with the terms of USACE Purchase Order No. DACW45-95-P-1084/Purchase Request No. EDGG*A-5192-0013 dated July 27, 1995. Quadrel's principal contact for this project has been Mr. Rick Grabowski.

1.0 OBJECTIVES

At the request of USACE, Quadrel conducted an EMFLUX® Survey of a 45-acre section of the HIMCO Dump, a Superfund Site in Elkhart County, Indiana. The purpose of this EMFLUX® Methane Survey was to verify the presence of methane and, assuming verification, to estimate the annual Methane generation rate.

2.0 BACKGROUND

Based on publicly available information¹, the HIMCO Dump is a closed and covered landfill that operated between 1960 and September 1976. The area was initially marsh and grassland; no liner, leachate, or gas-recovery system was constructed for the landfill. It has been reported that essentially two-thirds of the waste in the landfill is calcium sulfate from Miles Laboratories; also present are demolition/construction debris, industrial and hospital wastes, and general household wastes. In 1977 the landfill was closed and covered, using six inches of Calcium Sulfate and one foot of sand.

The Dump is currently surrounded by small wooded areas and interrupted wetlands. The central and eastern portions of the Survey area are characterized by light to heavily wooded terrain and scrub brush, while the western portion is primarily an open field of tall grass.

¹U.S. EPA, Region V, *Health and Safety Plan, HIMCO Dump Remedial Investigation/Feasibility Study, Elkhart, Indiana*, Volume 4, July 1990, p. 3-1 through 3-3.

3.0 INVESTIGATION PLAN

The subparagraphs below describe the overall Survey plan, the work carried out in the field, the schedule followed, and the quality-assurance and quality-control (QA/QC) procedures used.

3.1 Approach

This EMFLUX® Methane Survey utilized Quadrel's proprietary model which relates earth-tide phenomena to significant fluctuations in vertical gas flow through the earth's crust, thereby substantially increasing sampling sensitivity and accuracy. The Survey involved a total of 77 points deployed in a modified grid covering the landfill area and including representative points within 50 feet of landfill boundaries.

Three Landtec GA-90 Infrared Gas Analyzers were used to measure Methane and Carbon Dioxide concentrations. The sampling procedure required multiple, timed withdrawals of gas from shallowly embedded collection probes (at to depths of approximately 18 inches). After each measurement the field instruments were allowed to "zero-out" by sampling ambient-air until both Methane and Carbon Dioxide concentrations registered 0.0%. Readings were taken every four hours over a 24-hour schedule. The frequency and schedule were chosen to track vertical gas velocities predicted by Quadrel's earth-tide model for this site and period.

Upon completion of field work gas-sample concentrations were used to calculate average Methane generation rates for each sample point. Following areal integration of those values, an annualized methane-generation rate for the landfill was calculated.

3.2 Survey Plan

The Survey plan for this investigation is shown in **Figure 1**. The grid pattern employed called for emplacement of 77 shallow collection tubes, most of which were on 200-foot centers along lines trending 0°/180° True (corrected for current local 4° West Declination). Sampling locations on the outer rim of the grid were placed about 50 feet from the observed boundary of the landfill.

3.3 Site Preparation

Survey lines were laid out by Quadrel personnel using a magnetic compass. Scrub brush and small trees were removed for surveying purposes, and to improve access to sampling locations.

The EMFLUX® Methane collection tubes were driven to a uniform depth of 18 inches leaving six inches of the tube above ground (field procedures are provided in **Appendix A**).

3.4 Field Work

Sample point locations were determined and the Survey area staked on August 7 and 8, 1995. EMFLUX® Methane collection tubes were deployed on August 8 and capped at 0800 hours on August 9; all devices were retrieved on August 10, 1995.

Weather conditions for the most part were clear, but there was a brief period of rain during the afternoon hours of Wednesday, August 9. However, meteorological phenomena are not usually significant factors in EMFLUX® Surveys.

Deployment and retrieval of EMFLUX® devices were accomplished in conformity with Quadrel's established Field Procedures (Appendix A).

3.5 Quality Assurance/Quality Control

Field work and reporting were done in accordance with Quadrel's Quality Assurance Program Plan.

4.0 FINDINGS

The following section outlines results of the EMFLUX® investigation of the HIMCO Dump.

4.1 Computations

The Methane percentages obtained in the field were averaged over time at each point, and the results were converted to emission flux rates ($\text{ng cm}^{-2} \text{s}^{-1}$) and then to annualized generation rates (in cubic feet per year, $\text{ft}^3 \text{yr}^{-1}$) using the following equation.

$$F = P^{4/3} D_a ((C_z N 100)/Z)$$

where: F = Average emission flux rate ($\text{ng cm}^{-2} \text{s}^{-1}$),
 P = Porosity,
 D_a = Diffusivity coefficient ($\text{cm}^2 \text{s}^{-1}$),
 C_z = Methane concentration (percent),
 N = Dimensional conversion factor (for Methane $7,160 \text{ ng cm}^{-3}$),
 100 = Percent conversion factor, and
 Z = depth (cm)

Based on published porosities², the average porosity for the mixed sand used in the cap of the HIMCO Dump was assumed to be 0.35; the diffusivity coefficient D_a of Methane in free air is $0.165 \text{ cm}^2 \text{s}^{-1}$.

²Todd, D.K., *Ground Water Hydrology* (New York: 1959).

The calculated flux values were plotted and manually contoured (see Figures 2 and 3), then the resulting isopleths were numerically integrated to provide an estimate of the total annualized Methane production rate in cubic feet per year using the following equation.

$$F \text{ (total), ng s}^{-1} = ((F_1 + F_H)/2)(A_1) + ((F_2 + F_1)/2)(A_2 - A_1) + ((F_3 + F_2)/2)(A_3 - A_2) + \dots + ((F_n + F_{n-1})/2)(A_n - A_{n-1})$$

where: F = Flux rate, (ng cm⁻² s⁻¹) A = Area, cm²

F_H = Highest Emission Rate

F_1 = Highest Contour

F_2

.

.

.

F_n

A_1

A_2

.

.

.

A_n

with: $1 \text{ ng/s} = 1.557 \times 10^3 \text{ ft}^3/\text{yr}$

4.2 Data

The Methane concentration data collected in the field are summarized in Table 1 by probe number, time, and percent Methane in each sample. The table also provides values averaged over time at each probe location, as well as the range and range factor (high value divided by low value) for Methane percentages.

Readings for probes 4, 5, 8, 9, and 27 through 52 scheduled for 1200 hours on August 9 were not used in the calculation of the mean Methane percentages because of equipment difficulties during that initial sampling.

No information is available for samplings taken at probe 5 at 1200 hours and at probe 70 at 1600 hours on August 9, because water in those probes was inadvertently drawn into the analyzer's intake tube, terminating these readings.

Table 2 presents Methane-generation rates, in nanograms per square centimeter per second (ng cm⁻² s⁻¹), as calculated from concentration data.

5.0 DISCUSSION

5.1 Summary

Quadrel obtained varying but substantial Methane readings at 37 probe locations, most of which were within the boundaries of the landfill area; values ranged from 0.1 ng cm⁻² s⁻¹ to 496.7 ng cm⁻² s⁻¹. By contrast, the company found no traces of Methane at 40 locations, most of which were near the perimeter or outside of the landfill.

Based on the data collected during the 24-hour Survey period, Quadrel estimates that the HIMCO Dump Superfund Site is producing Methane at an annualized rate of 287 million cubic feet per year (ft³ yr⁻¹).

5.2 Commentary

- 5.2.1 The highest mean Methane concentration, 64.9%, occurred at probe 45; the next three highest values, 57.8%, 55.0%, and 51.6%, were found at probes 8, 24, and 9, respectively.
- 5.2.2 The majority of Methane detected was found in two large groupings of detections located in the central and western portions of the landfill (Figure 3). These groupings are separated by nondetections at probes 11, 15, 22, and 31 and by low detections at probes 16, 32, and 37. It is of possible significance to note that the areas of high detection (above 200 ng cm⁻² s⁻¹) appear to track to the main landfill access road shown in Figure 1.
- 5.2.3 Isolated, but possibly significant detections were made at probes 61, 62, and 77 near the southeastern perimeter of the HIMCO Site (Figures 2 and 3).
- 5.2.4 Olfactory detections of Hydrogen Sulfide were made by all three Quadrel field teams during each scheduled sampling period. It was observed that those probe locations which produced a strong Hydrogen Sulfide odor also yielded high Methane detections.
- 5.2.5 Methane detections on the HIMCO Dump were found at very consistent levels, with the average range factor for all points being only 5.2%. While large and predictable fluctuations in Methane emissions are generally associated with areas of subsurface soil-gas migration, consistent Methane emission levels such as those found on this site typically indicate areas currently producing Methane.

Table 1
Methane Concentrations (%)
HIMCO Dump Superfund Site, Elkhart, IN

Date	8/9/95			8/10/95			Mean	Range		
	Time	1200 hours	1600 hours	2000 hours	0000 hours	0400 hours		0800 hours	Low	High
Sample										
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
3	1.2%	0.9%	1.1%	0.1%	0.0%	0.0%	0.6%	0.0%	1.2%	--
4	0.0% *	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	--
5	NI *	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	--
6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
7	8.8%	8.7%	8.6%	8.3%	8.2%	8.5%	8.5%	8.2%	8.8%	1.1
8	0.0% *	58.1%	57.3%	57.9%	57.5%	58.3%	57.8%	57.3%	58.3%	1.0
9	0.0% *	51.8%	51.1%	51.1%	51.5%	52.4%	51.6%	51.1%	52.4%	1.0
10	38.6%	39.8%	39.7%	40.1%	40.8%	40.7%	40.0%	38.6%	40.8%	1.1
11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	--
14	31.6%	31.3%	31.0%	31.1%	31.2%	31.8%	31.3%	31.0%	31.8%	1.0
15	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
16	0.1%	0.0%	0.1%	0.0%	0.3%	0.3%	0.1%	0.0%	0.3%	--
17	20.7%	0.9%	0.4%	0.3%	0.5%	0.8%	3.9%	0.3%	20.7%	69.0
18	42.5%	42.5%	42.0%	41.9%	41.5%	42.0%	42.1%	41.5%	42.5%	1.0
19	16.1%	16.3%	15.9%	16.0%	15.6%	16.5%	16.1%	15.6%	16.5%	1.1
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--

Note: * These measurements have not been used in the calculation of Mean values because of equipment difficulties in the field.
 NI No information is available because water in the analyzer tube terminated these samplings.

**Table 1 (cont.)
Methane Concentrations (%)
HIMCO Dump Superfund Site, Elkhart, IN**

Date	8/9/95			8/10/95			Mean	Range		
	Time	1200 hours	1600 hours	2000 hours	0000 hours	0400 hours		0800 hours	Low	High
Sample										
21	31.7%	31.8%	31.6%	31.5%	32.0%	31.8%	31.7%	31.5%	32.0%	1.0
22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
23	51.8%	0.8%	0.3%	0.2%	0.3%	10.7%	10.7%	0.2%	51.8%	259.0
24	55.3%	55.0%	55.3%	54.5%	55.2%	54.5%	55.0%	54.5%	55.3%	1.0
25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
26	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
27	0.0% *	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	0.3%	0.2
28	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
29	16.9% *	18.7%	19.2%	19.3%	19.7%	19.7%	19.3%	18.7%	19.7%	1.1
30	0.0% *	29.9%	31.3%	30.8%	31.6%	31.8%	31.1%	29.9%	31.8%	1.1
31	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
32	0.0% *	1.4%	1.2%	1.1%	0.8%	0.6%	1.0%	0.6%	1.4%	2.3
33	0.0% *	3.1%	2.2%	1.3%	1.0%	0.7%	1.7%	0.7%	3.1%	4.4
34	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
35	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
36	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--
37	0.0% *	1.3%	1.2%	1.2%	1.2%	1.3%	1.2%	1.2%	1.3%	1.1
38	0.0% *	30.4%	30.2%	30.5%	30.4%	30.6%	30.4%	30.2%	30.6%	1.0
39	0.0% *	32.3%	48.0%	48.9%	48.3%	48.8%	45.3%	32.3%	48.9%	1.5
40	0.0% *	0.5%	0.8%	1.3%	1.9%	0.9%	1.1%	0.5%	1.9%	3.8

Note: * These measurements have not been used in the calculation of Mean values because of equipment difficulties in the field.
 NI No information is available because water in the analyzer tube terminated these samplings.

7

**Table 1 (cont.)
Methane Concentrations (%)
HIMCO Dump Superfund Site, Elkhart, IN**

Date	8/9/95						8/10/95		Range			
	Time	1200 hours	1600 hours	2000 hours	0000 hours	0400 hours	0800 hours	Mean	Low	High	Factor	
Sample												
41	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
42	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
43	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
44	0.0% *	46.6%	45.8%	46.6%	46.5%	47.2%	46.5%	45.8%	47.2%	1.0		
45	0.0% *	64.9%	64.4%	64.4%	65.4%	65.6%	64.9%	64.4%	65.6%	1.0		
46	0.0% *	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	--		
47	0.0% *	0.0%	0.0%	5.0%	1.3%	0.7%	1.4%	0.0%	1.5%	--		
48	0.0% *	0.0%	0.0%	0.0%	0.0%	0.8%	0.2%	0.0%	0.8%	--		
49	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
50	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
51	0.0% *	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
52	0.0% *	11.2%	11.7%	13.2%	14.0%	14.9%	13.0%	11.0%	14.9%	1.4		
53	7.6%	7.8%	7.2%	7.6%	7.6%	7.2%	7.5%	7.2%	7.8%	1.1		
54	2.8%	1.8%	1.8%	1.8%	2.0%	1.4%	1.9%	1.4%	2.8%	2.0		
55	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
56	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
57	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
58	3.7%	5.0%	2.9%	5.8%	6.2%	6.9%	5.1%	2.9%	6.9%	--		
59	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		
60	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--		

Note: * These measurements have not been used in the calculation of Mean values because of equipment difficulties in the field.
 NI No information is available because water in the analyzer tube terminated these samplings.

**Table 1 (cont.)
Methane Concentrations (%)
HIMCO Dump Superfund Site, Elkhart, IN**

Date	8/10/95						Range				
	8/9/95 Time	1200 hours	1600 hours	2000 hours	0000 hours	0400 hours	0800 hours	Mean	Low	High	Factor
Sample											
61	4.2%	4.2%	4.3%	4.3%	4.4%	4.5%	4.3%	4.2%	4.4%	1.0	
62	45.8%	52.0%	44.3%	53.7%	52.8%	53.0%	50.3%	44.3%	53.7%	1.2	
63	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
64	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
65	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
66	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
67	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	--	
68	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
69	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
70	0.0%	<i>NI</i>	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
71	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
72	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
73	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
74	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
75	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
76	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	
77	9.9%	9.6%	9.1%	9.2%	9.0%	8.1%	9.2%	8.1%	9.9%	1.2	

Note: * These measurements have not been used in the calculation of Mean values because of equipment difficulties in the field.
NI No information is available because water in the analyzer tube terminated these samplings.

6

Table 2
Average Methane Generation Rates (ng cm⁻² s⁻¹)
HIMCO Dump Superfund Site, Elkhart, IN

Methane Generation Rate							
Sample	(ng cm ⁻² s ⁻¹)	Sample	(ng cm ⁻² s ⁻¹)	Sample	(ng cm ⁻² s ⁻¹)	Sample	(ng cm ⁻² s ⁻¹)
1	0.0	21	242.7	41	0.0	61	33.0
2	0.0	22	0.0	42	0.0	62	384.5
3	4.2	23	81.7	43	0.0	63	0.0
4	0.2	24	420.4	44	356.0	64	0.0
5	0.2	25	0.0	45	496.7	65	0.0
6	0.0	26	0.0	46	0.2	66	0.0
7	65.1	27	0.0	47	10.7	67	0.3
8	442.2	28	0.0	48	1.2	68	0.0
9	394.5	29	147.8	49	0.0	69	0.0
10	305.5	30	237.7	50	0.0	70	0.0
11	0.0	31	0.0	51	0.0	71	0.0
12	0.0	32	7.8	52	99.4	72	0.0
13	0.1	33	12.7	53	57.4	73	0.0
14	239.6	34	0.0	54	14.8	74	0.0
15	0.0	35	0.0	55	0.0	75	0.0
16	1.0	36	0.0	56	0.0	76	0.0
17	30.1	37	9.5	57	0.0	77	70.0
18	321.7	38	232.7	58	38.9		
19	122.9	39	346.2	59	0.0		
20	0.0	40	8.3	60	0.0		

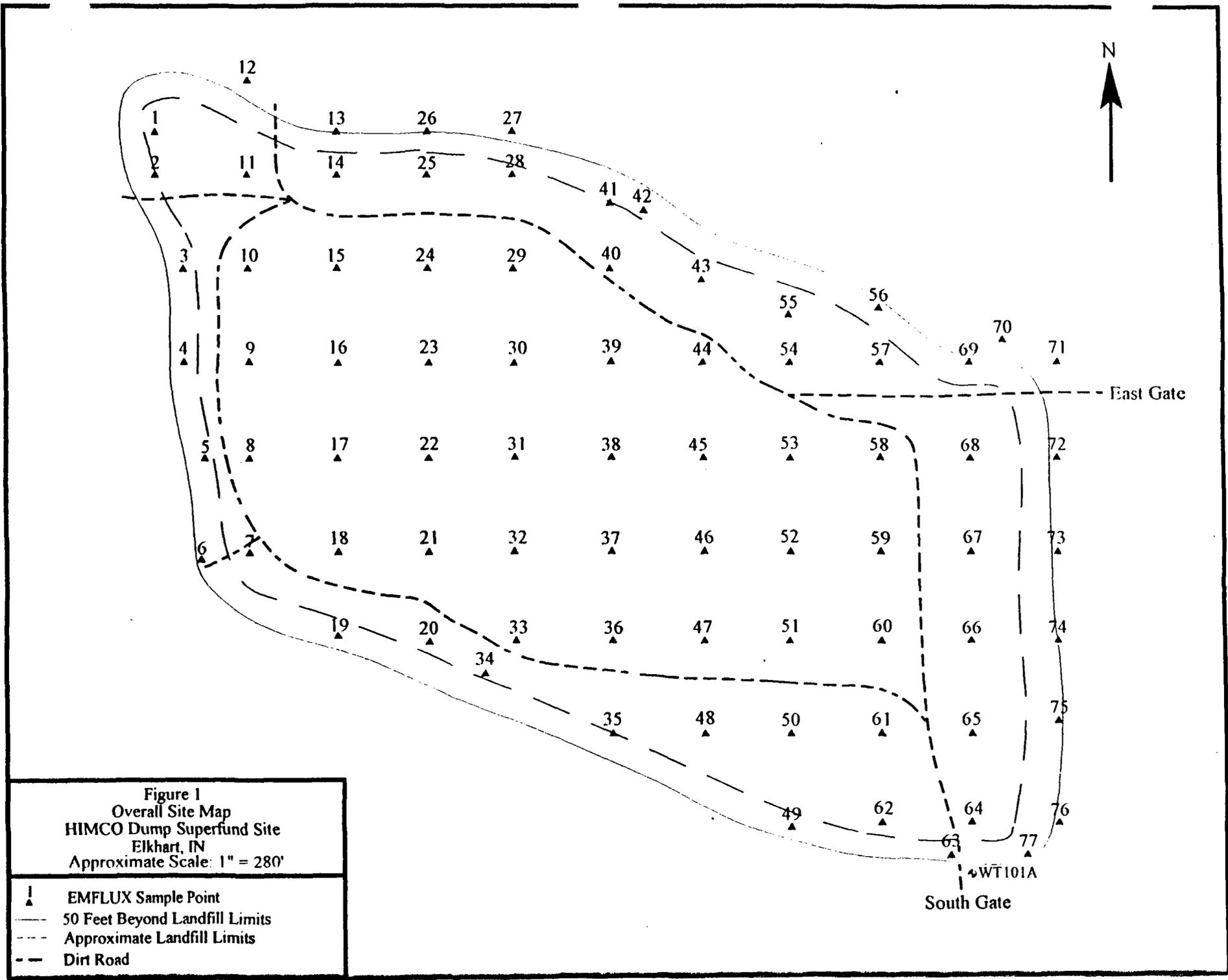


Figure 1
Overall Site Map
HIMCO Dump Superfund Site
Elkhart, IN
Approximate Scale: 1" = 280'

- ▲ EMFLUX Sample Point
- 50 Feet Beyond Landfill Limits
- Approximate Landfill Limits
- . - . - . Dirt Road

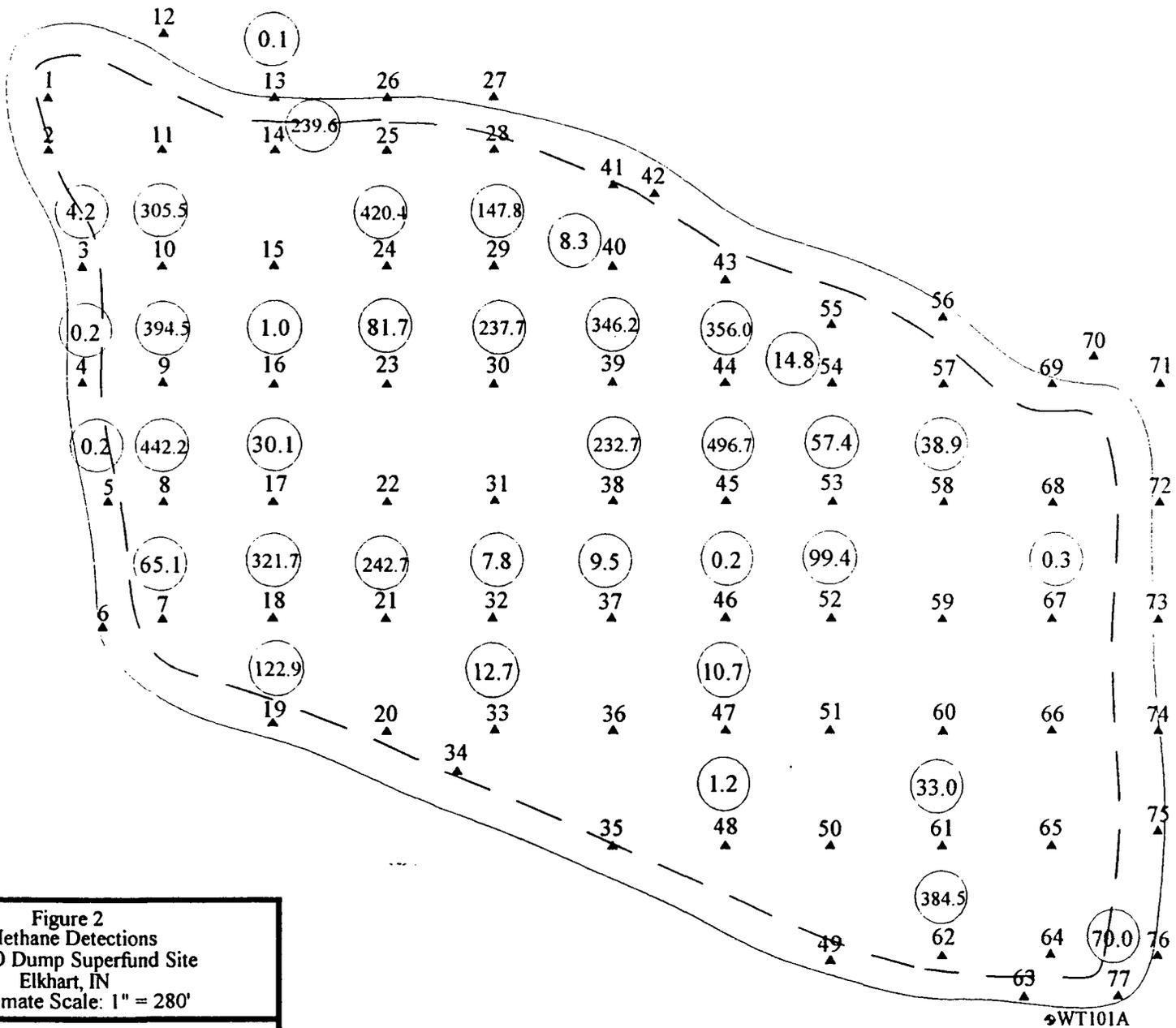
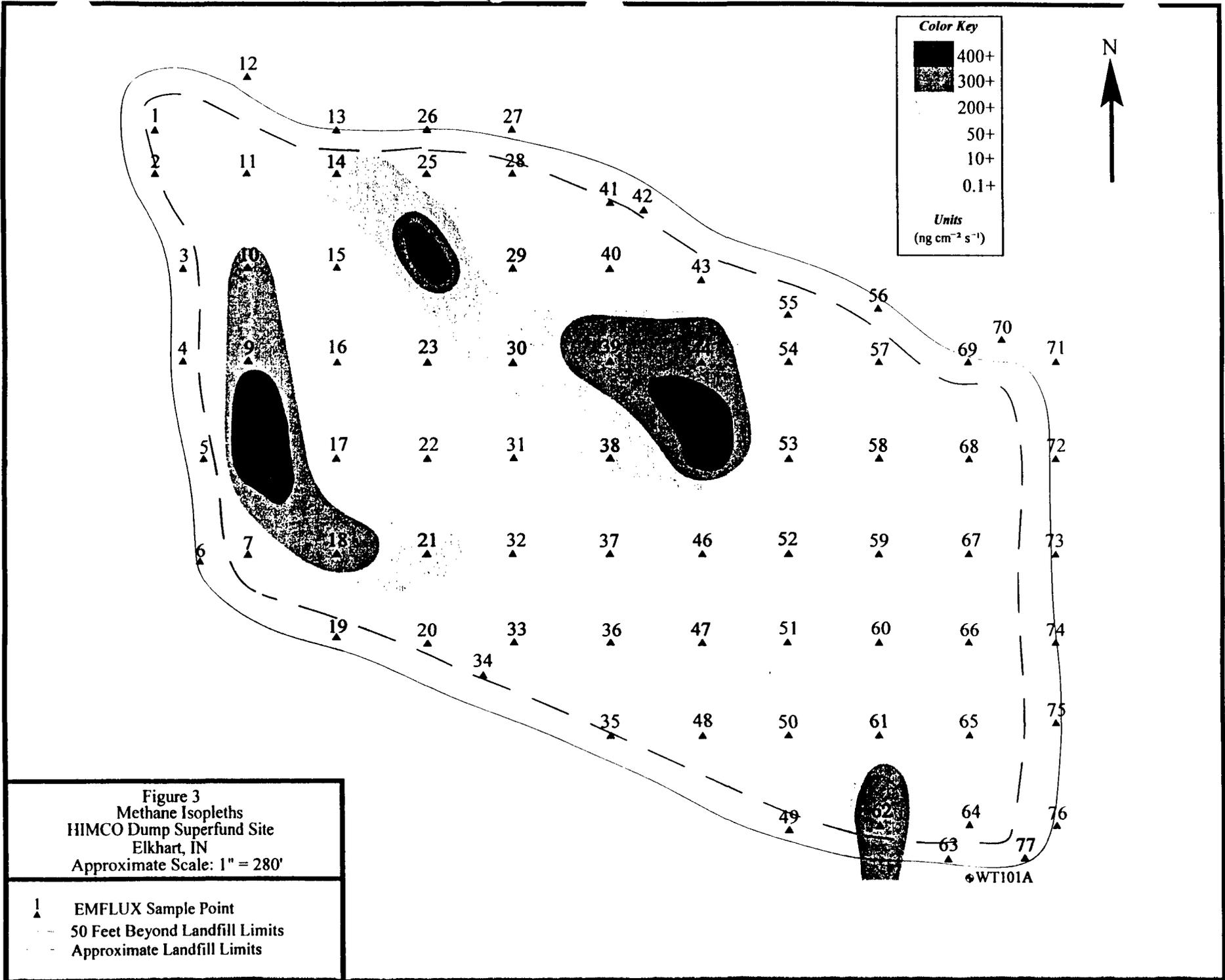


Figure 2
Methane Detections
HIMCO Dump Superfund Site
Elkhart, IN
Approximate Scale: 1" = 280'

- EMFLUX Sample Point
- 50 Feet Beyond Landfill Limits
- Approximate Landfill Limits
- Methane Generation Rates (ng cm² s⁻¹)



Appendix A

EMFLUX[®] Methane Survey Field Procedures

- A. At each survey point, the team drives a 24-inch long, 1/2-inch i.d. tube 18-inches into the ground by means of a pointed solid steel slam bar snugly fitted into the tube; the tube is then purged with air appropriately scrubbed according to the targeted analyte and the top is sealed with a polyethylene twistcock in the closed position.
- B. At a predetermined time, a field team (Members A and B) begins sequentially sampling the captured gas in each shallow depth tube with a methane gas analyzer. Member A carries and reads the analyzer while Member B connects and disconnects the analyzer to the sampling tube and records field notes (i.e., date, time, location, and measurements). Specifically, at each sample location Member B connects the analyzer to the twistcock, twists the cock to the open position, leaves it open for 30 seconds, returns the cock to the closed position, then disconnects the analyzer from the twistcock. While the twistcock is in the open position, Member A watches the analyzer's readout and reports to Member B the observed measurements, who then records them. The team then moves on to the next sample location and repeats the procedure until all probes have been sampled.
- C. This sampling is conducted on a predetermined schedule, generally every four hours for 24 to 48 hours. Once the predetermined number of sampling cycles have been completed, the team recovers all probes, seals the abandoned holes (if required), and leaves the site, taking with it all equipment.

Appendix B
Field Deployment Report

QUADREL SERVICES, INC.
METHANE DATA SHEET

CLIENT: U.S. Army Corps of Engineers - Omaha SITE: HIMCO Dump Superfund Site, Elkhart, IN

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
MTC/JW	8/9/95	1	1200	0.0	0.0	
		2	1202	0.0	0.2	
		3	1213	1.2	3.0	water in sampling probe drawn into analyzer's inlet tube
		4	1224	0.0	0.0	gas flow disrupted
		5	—	—	—	water in sampling probe terminated sampler analysis
		6	1310	0.0	0.6	
		7	1308	8.8	24.9	
		8	1229	0.0	0.0	gas flow disrupted
		9	1220	0.0	0.0	gas flow disrupted
		10	1211	38.6	30.7	
		11	1204	0.0	0.0	
		12	1206	0.0	2.2	
		13	1325	0.0	1.3	
		14	1323	31.6	34.9	
		15	1321	0.0	0.0	
		16	1318	0.1	0.6	
		17	1317	20.7	35.5	
		18	1313	42.5	32.0	

Client USACESite: Himco Landfill

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
DS/WHT	8-9-95	27	1200	0.0	1.6	
		28	1202	0.0	4.5	
		29	1205	16.9	31.1	
		30	1207	0.0	0.0	
		31	1209	0.0	0.0	
		32	1212	0.0	0.0	
		33	1214	0.0	0.0	
		34	1215	0.0	0.0	
		35	1217	0.0	0.0	
		36	1220	0.0	0.0	
		37	1221	0.0	0.0	
		38	1223	0.0	0.0	
		39	1226	0.0	0.0	
		40	1228	0.0	0.0	
		41	1230	0.0	0.0	
		42	1233	0.0	0.0	
		43	1236	0.0	1.4	
		44	1238	0.0	0.0	
		45	1240	0.0	0.0	
		46	1242	0.0	0.0	
		47	1244	0.0	0.0	
		48	1246	0.0	0.0	

QUADREL SERVICES, INC.
METHANE DATA SHEET

CLIENT: USACE

SITE: HIMCO LANDFILL

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
HO/BM	8/9/95	53	12:57	7.6	23.5	
		54	12:00	2.8	12.6	
		55	12:02	0.0	8.0	
		56	12:04	0.0	1.0	
		57	12:06	0.0	2.5	
		58	12:08	3.7	22.9	
		59	12:11	0.0	14.4	
		60	12:13	0.0	1.7	
		61	12:15	4.2	16.8	
		62	12:17	45.8	26.7	
		63	12:19	0.0	4.1	
		64	12:21	0.0	12.5	
		65	12:23	0.0	1.1	
		66	12:25	0.0	4.8	
		67	12:27	0.0	0.3	
		68	12:30	0.0	0.4	
		69	12:33	0.0	0.7	
↓	↓	70	12:36	0.0	0.0	DEW HARD; cut 10" off 1" h/bw ! IS RUPTED FEED

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
MTC FSW	8/9/95	1	16 07	0.0	2.8	
		2	16 09	0.6	1.8	
		3	16 20	0.9	1.6	Flow 2.5 Gallons (Water in tube)
		4	16 31	0.0	9.5	
		5	16 36	0.1	10.1	
		6	16 41	0.0	9.6	
		7	16 38	8.7	25.0	
		8	16 34	58.1	42.6	
		9	16 28	51.8	40.4	
		10	16 16	39.8	31.6	
		11	16 12	0.0	0.6	
		12	16 13	0.0	2.3	
		13	16 57	0.0	1.3	
		14	16 55	31.3	35.4	
		15	16 54	0.0	0.2	
		16	16 51	0.0	0.7	
		17	16 49	0.9	0.7	
		18	16 47	412.5	32.2	
		19	16 44	16.3	28.7	
		20	17 13	0.0	1.9	
		21	17 11	31.9	38.7	
		22	17 10	0.6	0.6	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Per	Remarks
DS/WH	8-9-95	27	1603	1.4	1	
		28	1605	0.0	0.0	
		29	1608	18.7	3.9	
		30	1610	29.9	35.4	
		31	1613	0.0	0.0	
		32	1616	1.4	1.3	
		33	1618	3.1	3	
		34	1619	0.0	0.8	
		35	1622	0.0	1	
		36	1624	0.0	5.5	
		37	1626	1.3	6.4	
		38	1628	30.4	1.1	
		39	1631	32.3	42.3	
		40	1635	0.5	1.7	
		41	1638	0.0	1	
		42	1640	0.0	9	
		43	1642	0.0	1	
		44	1645	46.6	3	
		45	1647	64.9	1	
		46	1649	0.0	5	
		47	1651	0.0	0.0	
	↓	48	1653	0.0	0.5	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
H0/BM	8/9/95	53	1607	7.8	23.9	Balances Pk's Rose to 7.8% CH ₄
		54	1613	1.8	13.4	
		55	1615	0.0	7.6	
		56	1617	0.0	0.1	
		57	1619	0.0	2.6	
		58	1621	5.0	19.4	
		59	1625	0.0	15.2	
		60	1626	0.0	1.7	
		61	1628	4.2	16.8	
		62	1631	52.0	28.6	
		63	1634	0.0	4.4	Pump Failure following reading
		64	1636	0.0	12.4	
		65	1638	0.0	1.4	
		66	1640	0.0	4.9	
		67	1642	0.2	0.4	
		68	1645	0.0	0.4	
		69	1648	0.0	1.4	
		70	1651	-	-	
		71	1653	0.0	0.6	
		72	1655	0.0	0.9	
		73	1657	0.0	1.2	Water in hose
		74	1659	0.1	3.0	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
MTG/SW	8-9-95	1	20.00	0.0	2.7	
		2	2003	0.0	1.8	
		3	2013	1.1	6.2	Water/Flow J. 4. salty
		4	2029	0.1	9.1	
		5	2034	0.0	9.7	
		6	2039	0.0	6.6	
		7	2037	8.6	24.7	
		8	2032	57.3	41.2	
		9	2016	51.1	40.3	Flow problems after #3
		10	2016	39.7	32.1	
		11	2006	0.0	0.0	
		12	2008	0.0	2.2	
		13	2057	0.0	1.3	
		14	2119	31.0	34.1	
		15	2054	0.0	0.1	
		16	2050	0.1	0.3	Flow problems
		17	2048	0.4	1.0	
		18	2042	42.0	32.3	
		19	2044	15.9	20.4	
		20	2113	0.0	1.8	
		21	2111	31.6	36.8	
		22	2109	0.0	0.0	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
DS/WH	8-9-95	27	2000	0.0	1.6	
		28	2002	0.0	5.1	
		29	2004	19.2	33.8	
		30	2006	31.3	36.2	
		31	2009	0.0	0.0	
		32	2012	1.2	0.9	
		33	2015	2.2	27.3	
		34	2018	0.0	8.7	
		35	2021	0.0	0.9	
		36	2024	0.6	25.0	
		37	2026	1.2	26.9	
		38	2030	30.2	41.3	
		39	2033	48.0	33.5	
		40	2035	0.8	0.9	
		41	2038	0.6	3.1	
		42	2041	0.0	2.9	
		43	2044	0.0	1.1	
		44	2047	45.8	37.9	
		45	2050	64.4	41.6	
		46	2052	0.0	3.6	
		47	2054	0.0	0.9	
	↓	48	2057	0.0	0.5	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
HO/am	8/9/95	53	2000	7.2	22.9	
		54	2002	1.8	13.8	
		55	2004	0.0	7.6	
		56	2006	0.0	1.0	
		57	2008	0.6	2.3	
		58	2010	2.9	7.7	
		59	2012	0.0	13.3	
		60	2014	0.0	0.6	
		61	2016	4.3	16.8	
		62	2020	44.3	24.3	
		63	2022	0.0	3.8	
		64	2024	0.0	11.1	
		65	2027	0.0	1.4	
		66	2027	0.0	4.3	
		67	2033	0.0	0.1	Water in tube cut 10" higher
		68	2036	0.0	0.6	
		69	2038	0.0	1.2	Opened hole on side of tube
		70	2042	0.0	0.0	
		71	2045	0.0	1.0	
		72	2048	0.0	1.4	
		73	2053	0.0	1.5	
↓	↓	74	2055	0.0	4.1	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
MTC/ SW	8/10/95	1	23 50	0.0	2.8	
		2	23 51	0.0	1.3	
		3	00 00	0.0	0.6	Water in hose / High water Table
		4	00 07	0.0	4.7	
		5	00 12	0.0	9.7	
		6	00 17	0.0	0.5	
		7	00 15	8.3	25.0	
		8	00 10	57.9	42.6	
		9	00 05	51.1	40.8	
		10	23 58	40.1	31.9	
		11	23 53	0.0	0.0	
		12	00 32	0.0	2.2	
		13	00 32	0.0	0.7	
		14	00 39	31.1	34.9	
		15	00 29	0.0	0.4	
		16	00 27	0.0	0.3	
		17	00 24	0.3	0.6	Flow Prob.
		18	00 19	41.9	31.9	
		19	00 21	16.0	28.0	
		20	00 49	0.0	1.7	
		21	00 47	31.5	37.1	
		22	00 45	0.0	0.0	NO Flow Prob.

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
DS/WH	8/10/95	27	0000	0.0	1.6	
		28	0002	0.0	5.6	
		29	0004	19.3	33.3	
		30	0007	30.8	35.5	
		31	0009	0.0	0.0	
		32	0012	1.1	0.8	
		33	0015	1.3	27.9	
		34	0018	0.0	5.0	
		35	0021	0.0	0.7	
		36	0023	0.0	6.8	
		37	0026	1.2	26.0	
		38	0029	30.5	40.1	
		39	0032	48.9	32.9	
		40	0034	1.3	1.1	
		41	0037	0.6	1.8	
		42	0040	0.0	2.9	
		43	0042	0.6	1.1	
		44	0044	46.6	38.2	
		45	0046	64.4	43.6	
		46	0048	0.0	3.2	
		47	0051	8.5	0.6	
		48	0053	0.1	0.2	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
HO/Bm	8/10/95	53	0000	7.6	24.5	
		54	0002	1.8	14.5	
		55	0004	0.0	8.3	
		56	0006	0.0	1.1	
		57	0008	0.0	2.6	
		58	0010	5.8	19.0	
		59	0012	0.0	15.6	
		60	0014	0.0	1.7	
		61	0016	4.3	16.9	
		62	0019	53.7	28.2	
		63	0021	0.0	4.5	
		64	0023	0.0	12.7	
		65	0025	0.0	1.5	
		66	0027	0.0	4.8	
		67	0029	0.0	0.0	
		68	0031	0.0	1.4	
		69	0033	0.0	0.0	
		70	0035	0.0	1.0	
		71	0037	0.0	1.4	
		72	0039	0.0	1.5	
		73	0041	0.6	4.3	
		74	0045	0.	0.2	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
MTC/SW	8-10-95	1	0357	0.0	2.7	
		2	0359	0.0	1.5	
		3	0408	0.0	8.9 ⁰	
		4	0413	0.0	28.9	
		5	0418	0.0	0.3 ^{2.6}	
		6	0422	8.2 ⁰	21.3 ^{0.3}	
		7	0420	8.2	24.3	
		8	0416	57.5	42.4	
		9	0411	51.5	41.6	
		10	0406	40.8	32.3	
		11	0401	0.0	0.0	
		12	0403	0.0	1.6	
		13	0437	0.0	0.7	
		14	0436	31.2	35.0	
		15	0434	0.0	0.3	
		16	0432	0.3	0.7	
		17	0429	0.5	1.5	Flow problems
		18	0424	41.5	32.1	
		19	0426	15.6	28.7	
		20	0452	0.0	1.2	
		21	0450	32.0	37.1	
		22	0448	0.0	0.0	No Flow Problems

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
PS WH	8-10-95	27	0400	0.0	1.7	
		28	0402	0.0	1.9	
		29	0404	19.7	34.2	
		30	0406	31.6	35.9	
		31	0408	0.0	0.0	
		32	04 ¹⁰ ₀₅	0.8	0.8	
		33	0412	1.0	27.1	
		34	0414	0.0	2.8	
		35	0416	0.0	0.4	
		36	0418	0.0	2.0 0.3	
		37	0421	1.2	26.1	
		38	0423	30.4	31.7	
		39	0425	48.3	32.8	
		40	0428	1.9	1.6	
		41	0430	0.0	1.0	
		42	0432	0.0	1.1	
		43	0434	0.0	0.4	
		44	0436	46.5	38.7	
		45	0438	64.5	43.9	
		46	0441	0.1	0.9	
		47	0443	1.3	1.1	
		48	0446	0.0	0.2	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
H0/Bm	8-10-95	53	0400	7.6	24.4	
		54	0402	2.0	14.8	
		55	0405	0.0	8.3	
		56	0407	0.0	1.1	
		57	0410	0.0	2.6	
		58	0412	6.2	19.2	
		59	0415	0.0	15.8	
		60	0417	0.0	1.7	
		61	0419	4.4	17.4	
		62	0422	52.8	28.4	
		63	0424	0.0	4.6	
		64	0426	0.0	13.0	
		65	0429	0.0	1.5	
		66	0433	0.0	4.8	
		67	0435	0.0	0.0	
		68	0437	0.0	0.7	
		69	0439	0.0	1.4	
		70	0441	0.0	0.0	
		71	0443	0.0	1.0 _w	
		72	0445	0.0	1.4	
		73	0447	0.0	1.5	
		74	7450	0.0	3	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
MZ/SW	8-10-95	1	0759	0.0	2.7	
		2	0800	0.0	1.5	
		3	0808	0.0	0.0	No Flow Problems
		4	0813	0.0	9.0	
		5	0817	0.0	8.2	
		6	0821	0.0	0.3	
		7	0819	8.5	25.4	
		8	0815	58.3	42.5	
		9	0811	52.4	40.8	
		10	0806	40.7	32.5	
		11	0802	0.0	0.3	
		12	0804	0.0	1.3	
		13	0836	0.1	1.3	
		14	0834	31.8	34.8	
		15	0833	0.0	0.3	
		16	0831	0.5	0.8	
		17	0828	0.8	1.4	Flow Problem
		18	0823	42.0	32.1	No smell
		19	0825	16.5	29.0	
		20	0850	0.0	1.0	
		21	0848	31.8	36.9	
		22	0846	0.0	0.0	No Flow Problem

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
DS/WH	8-10-95	27	0800	0.0	1.0	
		28	0802	0.0	1.8	
		29	0804	19.7	34.3	
		30	0806	31.8	36.5	
		31	0809	0.0	0.0	
		32	0812	0.6	0.6	
		33	0814	0.7	25.2	
		34	0816	0.0	2.4	
		35	0818	0.0	0.7	
		36	0820	0.0	3.0	
		37	0822	1.3	26.0	
		38	0825	30.6	41.4	
		39	0827	48.8	33.6	
		40	0829	0.9	0.7	
		41	0831	0.0	1.3	
		42	0833	0.0	1.5	
		43	0835	0.0	0.6	
		44	0837	47.2	38.6	
		45	0839	65.6	44.3	
		46	0842	0.0	2.5	
		47	0844	0.7	0.6	
		48	0846	0.8	0.2	

Team Initials	Date	Sample Number	Time (24 hours)	Percent Methane	Percent CO ₂	Remarks
HO/B m	8-10-95	53	0802	7.2	24.4	
		54	0804	1.4	12.4	
		55	0806	0.0	8.3	
		56	0808	0.0	1.0	
		57	0811	0.0	2.6	
		58	0813	6.9	14.2	
		59	0816	0.0	15.0	
		60	0818	0.0	1.7	
		61	0821	4.5	14.8	
		62	0824	53.0	28.3	
		63	0844	0.0	4.3	
		64	0846	0.0	12.5	
		65	0848	0.0	1.4	
		66	0849	0.0	4.6	
		67	0851	0.0	0.0	
		68	0853	0.0	0.5	
		69	0854	0.0	1.4	
		70	0856	0.0	0.0	
		71	0857	0.0	0.9	
		72	0859	0.0	1.2	
		73	0900	0.0	1.4	
		74	0903	0.0	4.0	

